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In order to improve vibration analysis of a signal measured on multi-component systems and especially on systems operating under non-stationary conditions, advanced signal processing methods are required. To contribute to this need a new diagnostic approach is presented in this work.

This paper focuses on some parts of an autonomous full-band spectrum analyzer, referred to as AStrion. AStrion consists different function blocks, referred to as "modules". In the first module, among other processing tasks, the signal is pre-processed with a new order tracking algorithm described in this paper. The subsequent modules, referred to as AStrion-I and AStrion-H, automatically identify all the harmonic series and modulation side-bands in all the frequency band of the signal [1].

The first module described in this paper is called AStrion-K, where K stands for Kinematic. This module associates the detected spectral structure, harmonic series and modulation side-bands, with the characteristic fault frequencies of the monitored system. This approach has the advantage of analyzing all the frequency band of the signal and of being able to monitor a system even if the kinematic of the system is unknown.

The second part of this paper describes the demodulation task, done by AStrion-M module. The demodulation is conducted over each carrier frequency along with its side-bands detected by AStrion-H. A multi-rate filtering process is applied over each band to isolate the component. Such filtering method down-samples the signal in such a way that the digital filter can achieve a satisfactory precision and stability over the targeted demodulation band, even if it is extremely narrow. In order to extract the corresponding deterministic component and to increase the signal to noise ratio, a time synchronous averaging is carried out over the filtered signal sampled according to the corresponding triggering frequency. Therefore, after computing the analytical signal of the averaged signal, a demodulation process estimates the amplitude and frequency functions, which are employed to derive fault indicators both in time and in frequency domains.

Finally, results are presented on real data gathered on a test bench designed in KAStrion project for simulating a wind turbine operation. This test bench was prepared to simulate all components of a wind turbine drive train and is composed of mechanisms for accelerated deterioration of bearings and gearbox, which allows the investigation of the wear of selected elements separately. This paper is focused on the fault of the main bearing. A comparison with commonly used fault indicators is carried out.

References

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